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Strain partitioning evolution and segmentation in hyperextended rift systems: insights from the Bay of Biscay and Pyrenees

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The understanding of the formation of hyper-extended domains has greatly benefited from combined studies at present-day and fossil rift systems preserved in collisional orogens. However, even though domains of extreme crustal and lithosphere thinning have been increasingly recognized, the spatial and temporal evolution of their tectonic processes remains poorly constrained.
The Bay of Biscay and Pyrenees correspond to a Late Jurassic to Mid Cretaceous rift system including both oceanic and hyper-extended rift domains. The transition from preserved oceanic and rift domains to the West to their complete inversion in the East provide simultaneous access to seismically imaged and exposed parts of a hyper-extended rift system. We combine seismic interpretations and gravity inversion results with field mapping to identify and map former rift domains from the Bay of Biscay margins to their fossil analogues preserved in the Pyrenean orogen. This onshore/offshore map of the rift systems enables us to investigate the spatial and temporal evolution and the strain distribution related to the formation of a strongly segmented rift system preserved at the transition between the European and Iberian plate boundary.
The restoration of the hyper-extended domains reveals the occurrence of spatially disconnected rift systems separated by weakly thinned continental ribbons (e.g. Landes High, Ebro block). While the offshore Bay of Biscay represent a former mature oceanic domain, the fossil remnants of hyper-extended domains preserved onshore in the Pyrenean–Cantabrian orogen record distributed extensional deformation partitioned between strongly segmented rift basins (e.g. Basque-Cantabrian, Arzacq-Mauléon basins). Rift system segmentation controls lateral variations of architecture and may be partly inherited from the pre-rift structuration. The relative timing of hyper-extensional processes is diachronous between the different rift systems recording the polyphased evolution of the European – Iberian plate boundary. Based on the subsidence and deformation history, we propose a scenario illustrating the strain partitioning evolution between the different rift systems. The results of this work may provide insights on the spatial and temporal evolution of the embryonic stages of other segmented rifted continental margins.